Calibration of a Full Scale Lateral Joint Model

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Abstract

Infiltration through lateral pipe joints has been a major source of problem in overloading wastewater treatment facilities. Chemical grouting has been used for years in solving the leaking problem at these joints. A full-scale lateral model was built and calibrated to investigate the leak rate at the lateral joints.

1. Introduction

Chemical Grouting has been successfully used in sealing infiltration at the pipe joints. Grouts, which are forced through the joints and cracks, fill the voids of the soil making a waterproof mass. It is of interest to investigate the behavior of lateral joint to leak rates with varying groundwater levels.

2. Objective

To determine the leak rates at the laterals with water pressure depicting the varying groundwater level.

3. Experimental Program

A rectangular box of 23 in. length and 35 in. in height and width (Figure 1) was used to simulate the field condition around the lateral connection. Deweyville grade #2 sand was used to fill the chamber. The main pipeline was 8 in. diameter with a 4 in. diameter pipe used as the lateral for constructing the model. The infiltration was measured at the joint by varying the water pressure up to 5 psi.

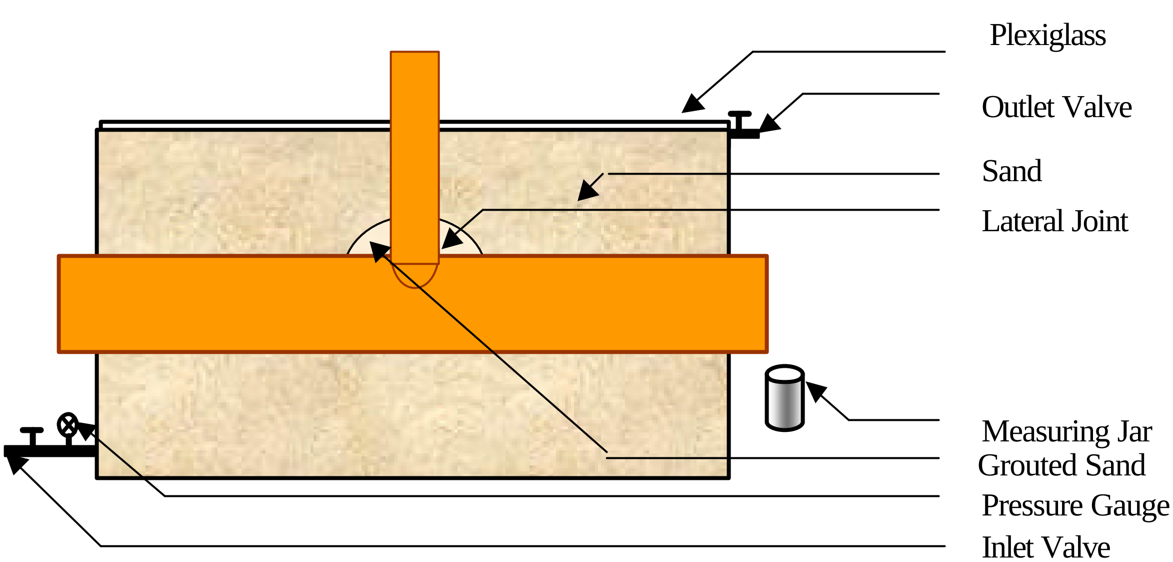

Figure 1. Set-up of Chamber for testing the lateral joint

4. Results and Discussion

The infiltration at the lateral joint increased with groundwater pressure as shown in Figure 2. For this joint, the infiltration rate of 2000 gpd at 1 psi almost doubled at 5 psi groundwater pressure.

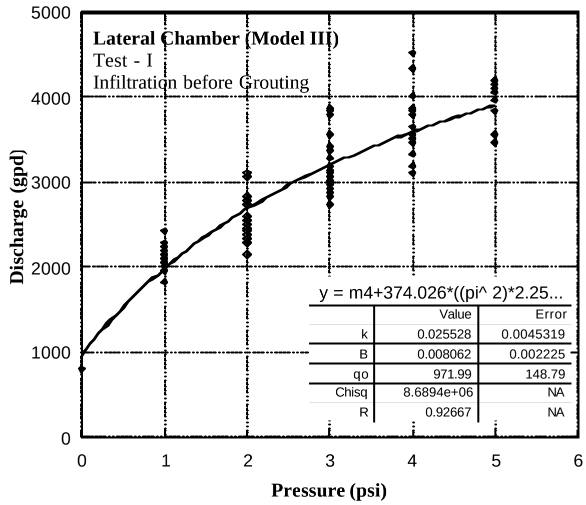

Figure 2. Relationship between discharge and pressure at the defective lateral joint

A mathematical model was proposed to determine the permeability of sand at the joint based on the leak rate shown in Figure 2.

$$q = q_o + \frac{p^2 R k h_2}{\ln\left(\frac{r_2}{r_1}\right) \times (1 + B h_2)}$$

where, q = flow rate, k = permeability of soil, R = Outer radius of the lateral, h_2 = Pressure of water in height, B = factor depends on the gap between the lateral and main line connection, r_2 = Radius of influence the discharge, r_1 = radius of the gap calculated from the area of the gap between the lateral and main line connection assuming it is a circle. Based on the leak rate, the permeability of the sand in the soil box was 6.5×10^{-2} cm/sec. The permeability of sand from ASTM D2434 – 68 was determined to be 1.2×10^{-1} cm/sec.

5. Conclusion

A lateral joint was constructed in a soil box and the infiltration rate was calibrated with pressure. A mathematical relation was used to represent the infiltration at the joint.

6. Acknowledgement

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7. Reference

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